NDCEE

National Defense Center for Environmental Excellence

DoD Executive Agent
Office of the Assistant Secretary of the Army (Installations and Environment)

NDCEE Sustainability Installations Initiatives Task

Near Zero Energy Housing at Ft. Campbell

Energy Modeling Results

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Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
MAY 2007		**00-00-2007 to 00-00-2007**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Near Zero Energy Housing at Ft. Campbell: Energy Modeling Results	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **National Defense Center for Energy and Environment,Operated by Concurrent Technologies Corporation,100 CTC Drive,Johnstown,PA,15904**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Joint Services Environmental Management (JSEM) Conference, May 21-24, 2007, Columbus, OH.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**18**	

Energy Modeling

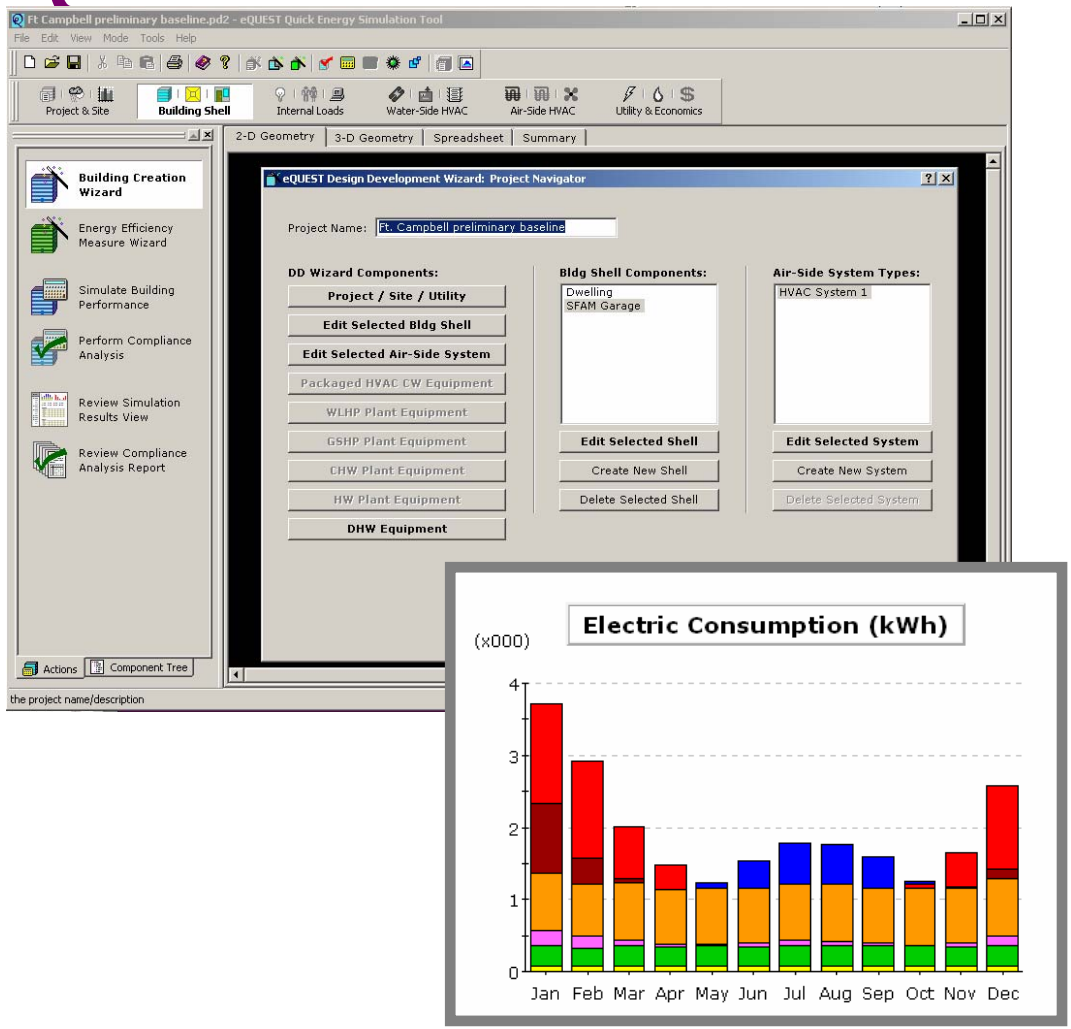
- Purpose
  - Assess the expected energy use of various building features and systems
- Task Application
  - Optimize ZEH design and size photovoltaics
- Software
  - eQUEST (DOE-2)
- Application Focus
  - Energy savings rather than detailed design
  - Comparative results for technologies

ZEH Design Approach

- Team members
  - Ft Campbell Housing
  - Actus Lend Lease
  - NDCEE
  - URS
- Technical Approach
  - Project scoping
  - Identification of Best Available Technologies (BATs)
  - Data collection
  - Develop modeling approach/run initial simulations
  - Evaluate approach/software capabilities/simulation results
  - Refine models and determine ZEH technology portfolio

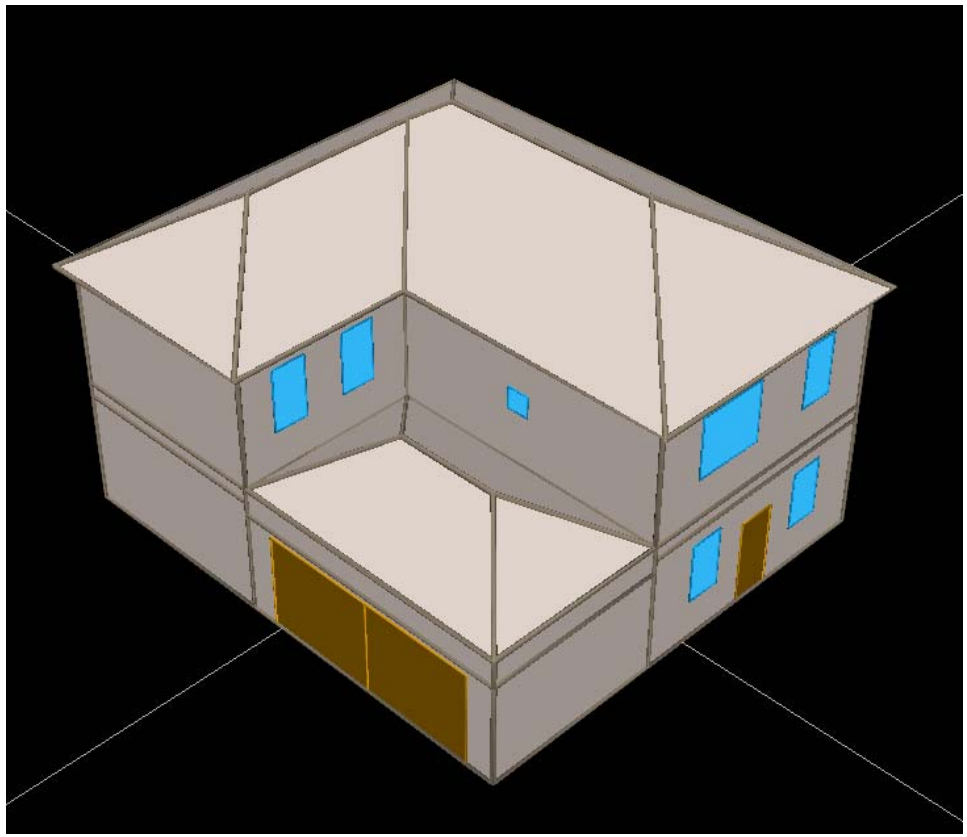
eQUEST

- Comprehensive energy simulation tool
- Publicly available
- Funded by California utility customers
- Administered by California Public Utilities Commission
- Simulation “engine” based on DOE-2 computer programs
- Modeler inputs building, system (HVAC, WH) and weather information
- Predicts hourly energy use and cost
- Building creation wizards
- Graphical reporting

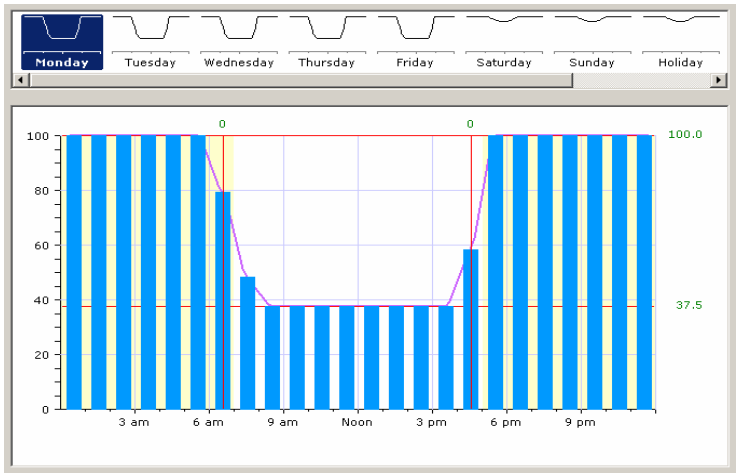


Baseline Ft. Campbell Single Family Home

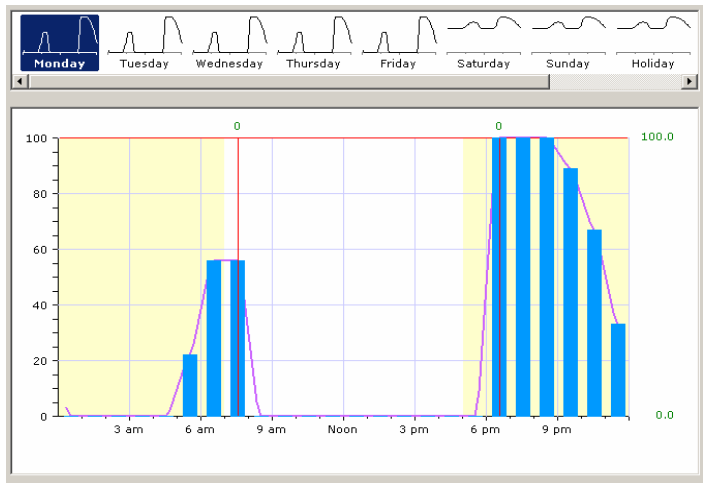
- 2 Story
- 2,100 ft^2 living space
- 325 ft^2 garage
- 2 x 4 metal frame
- R-13 batt in wall
- Asphalt shingle roof
- R-38 blown in cellulose
- Uninsulated slab foundation
- Double low-e windows
- Air source electric heat pump
- Electric water heater (20 gallons/person/day)
- Incandescent & fluorescent lighting
- West facing (worst case)



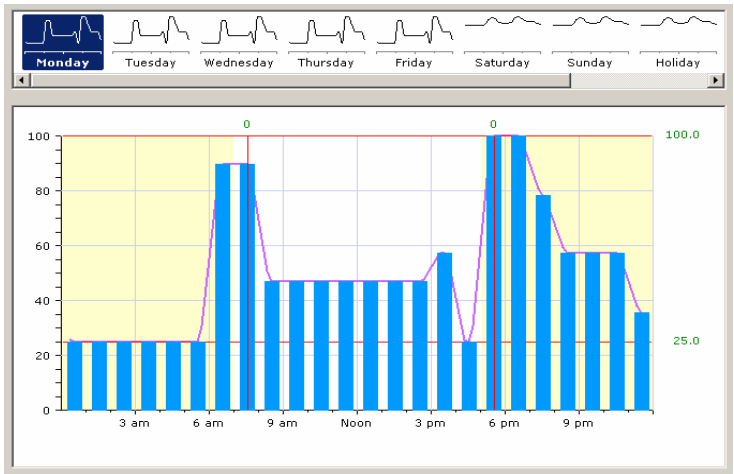
Profiles



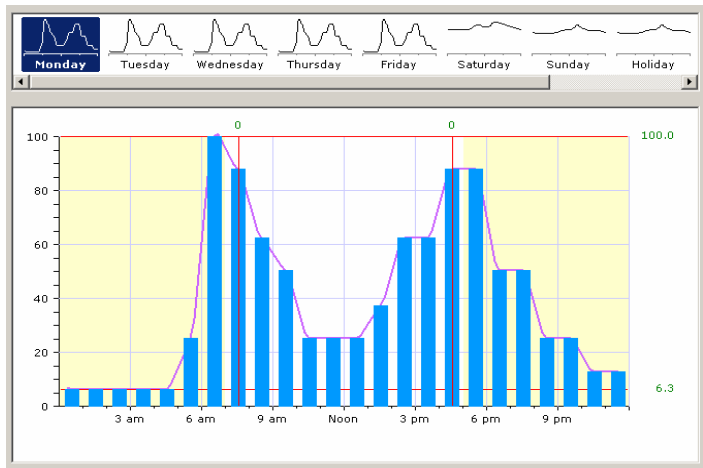
Occupancy



Lighting

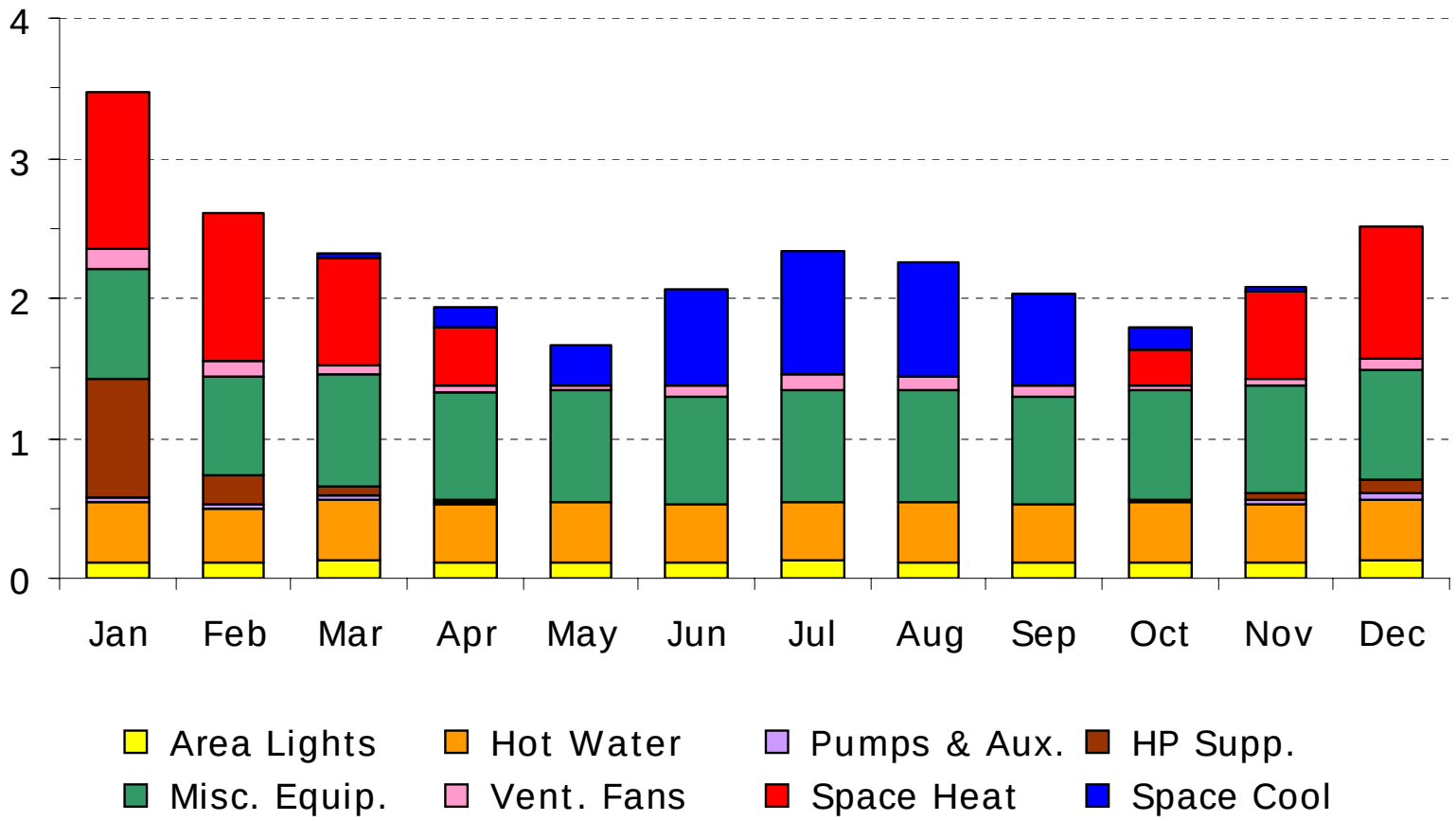


Equipment



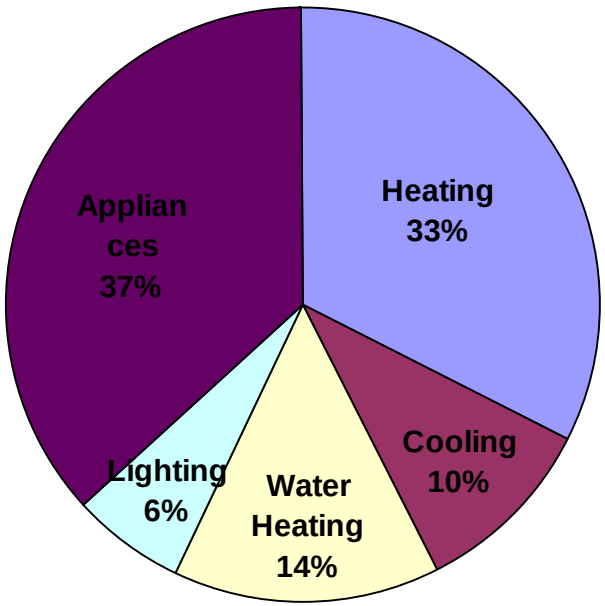
Hot Water

Baseline Electric Consumption (1,000 kWh)

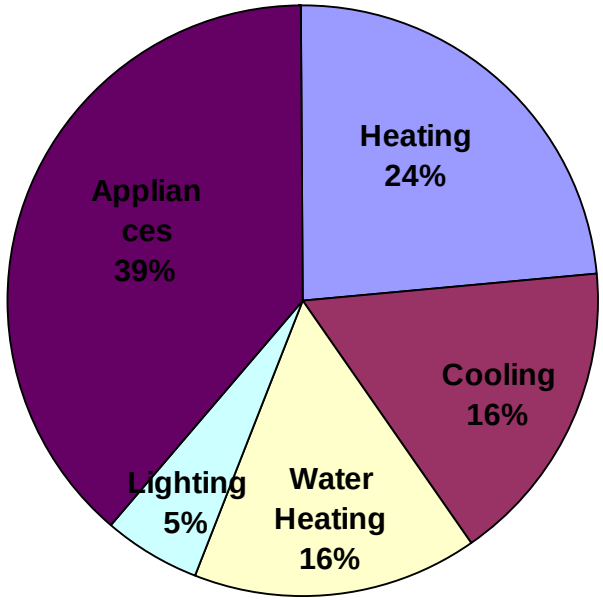


Comparison of Baseline Results to DOE RECS Data
(by Census Division)

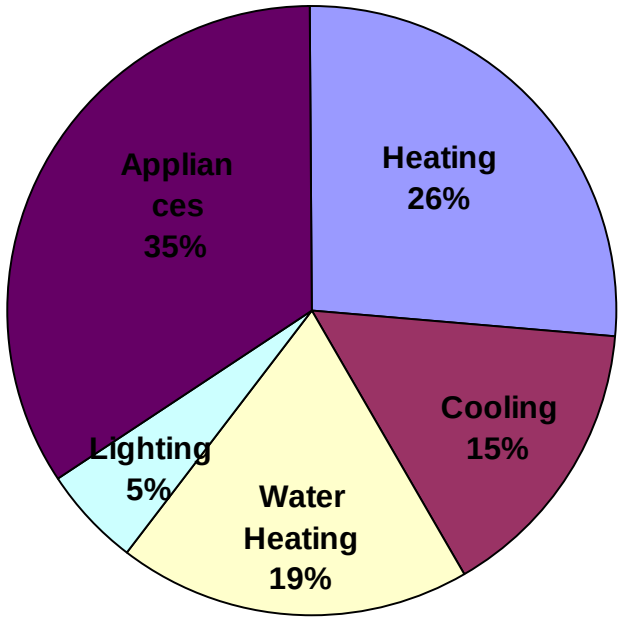
RECS Data
Midwest, East
North Central



RECS Data
South, East
South Central

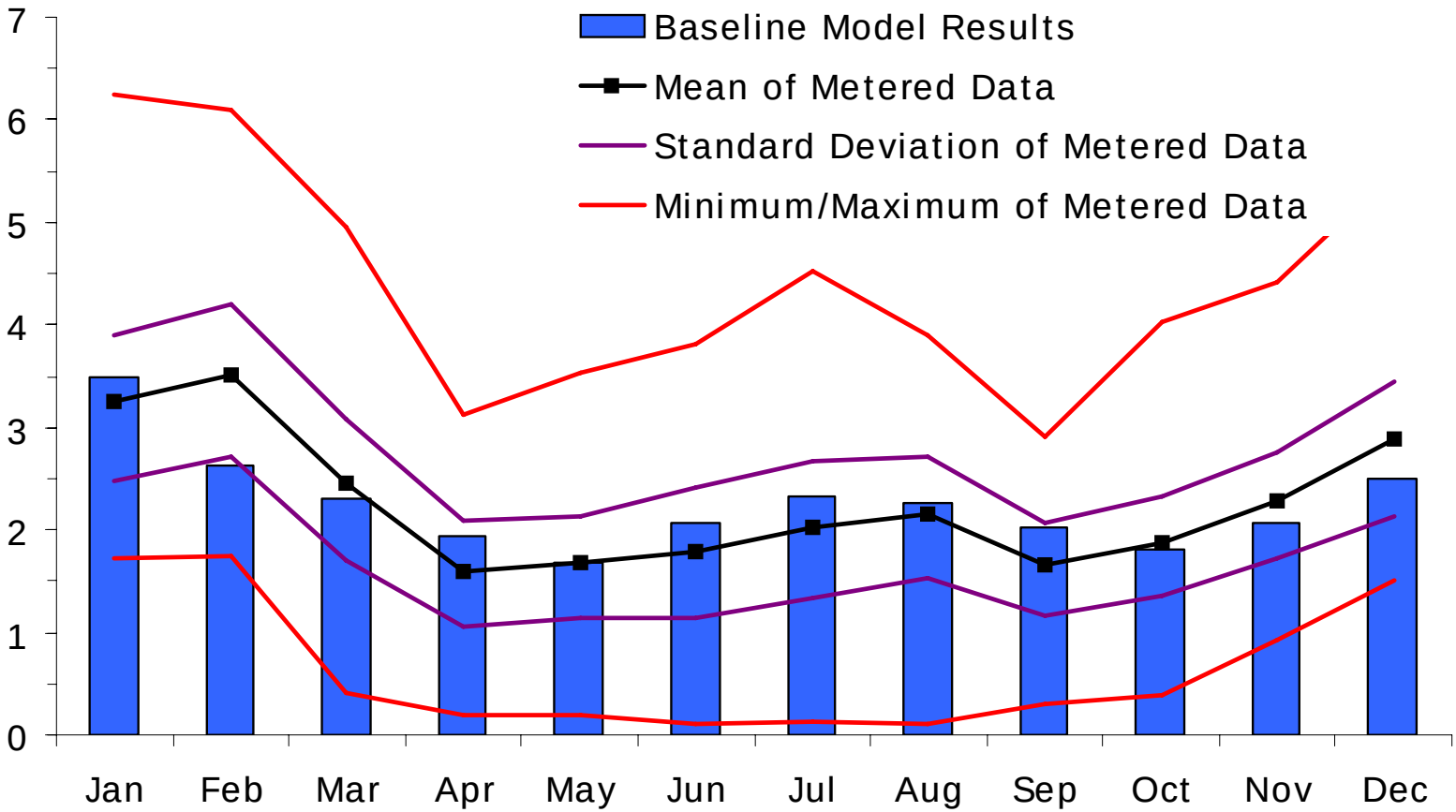


Ft Campbell
Baseline Energy
Model



RECS: Residential Energy Consumption Survey

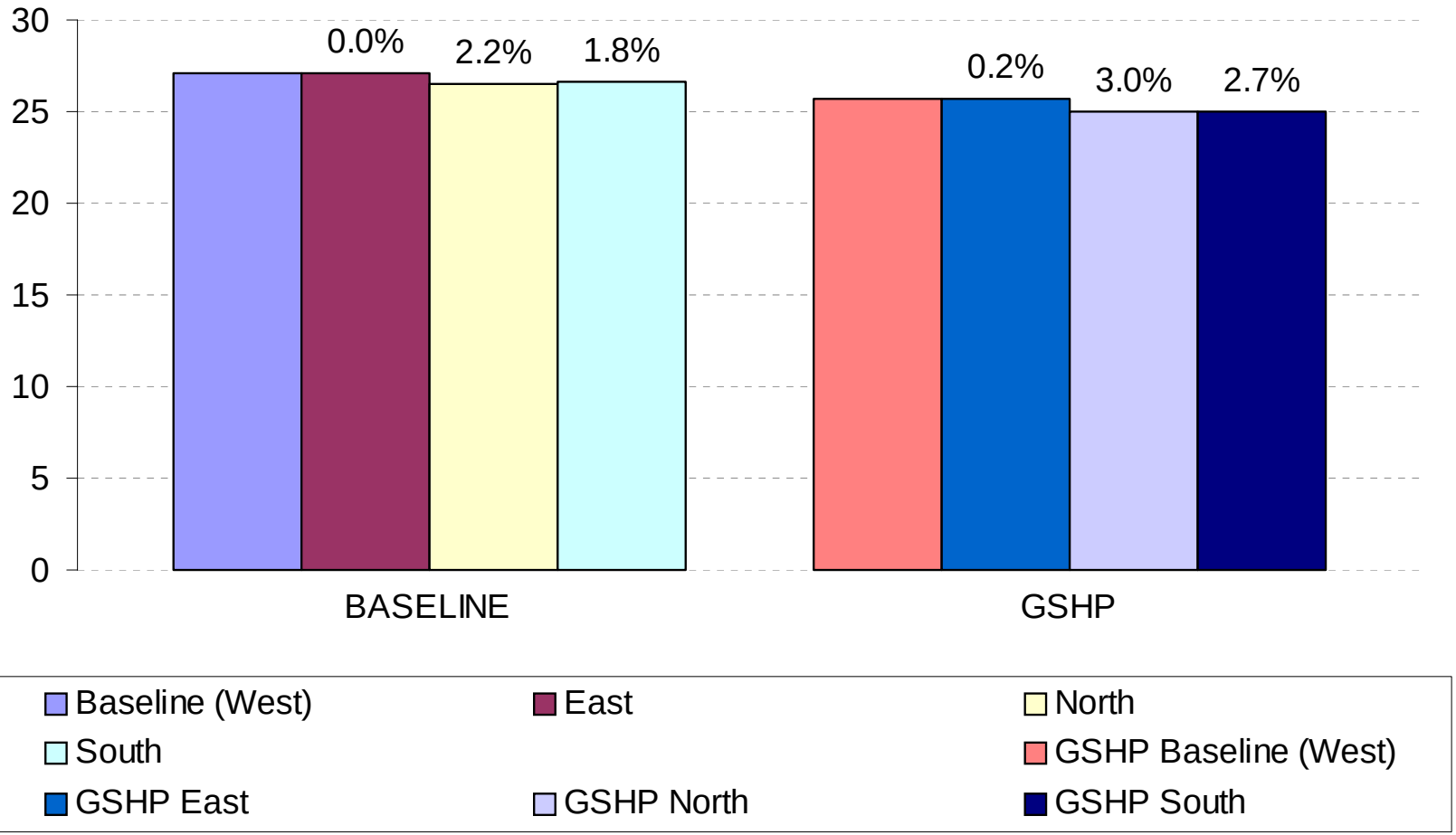
Comparison of Baseline Results to Metering Data



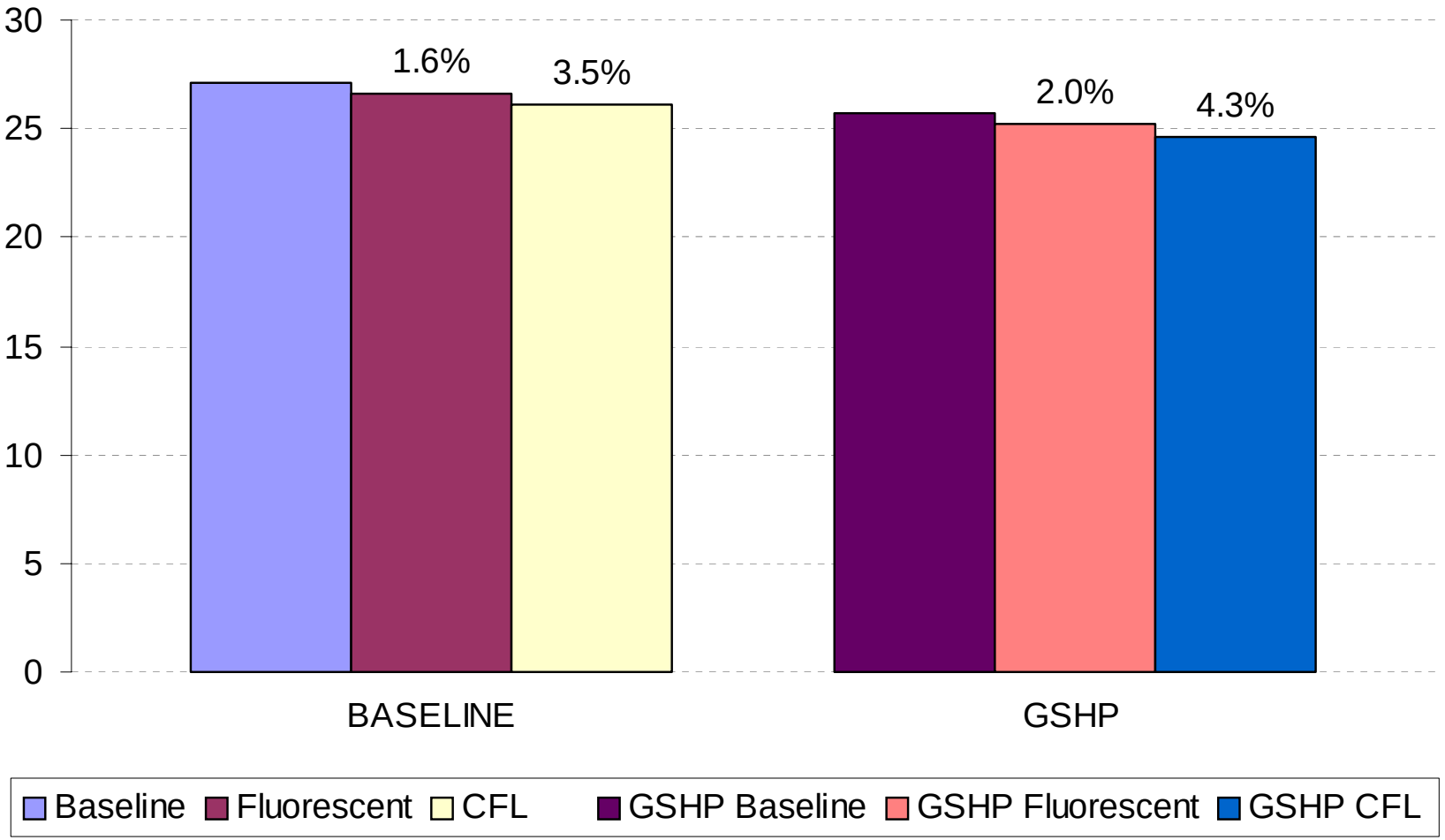
Evaluated Technologies

- Orientation
- Wall Construction: various stud sizes, wood, steel, SIP, ICF
- Insulation: R13 batt, spray foam, ICF, SIP
- Windows: double-glazed, low e vinyl, e film
- Doors: metal insulated, wood frame, removal of French doors, fins
- Overhangs: house, windows
- Roofing: asphalt, rubber, concrete, metal
- Attic Space: R30 blown w/ radiant barrier, vapor retarder, attic fan, radiant barrier drape, R45 blown
- Foundation: slab w/ and w/o insulation, crawl w/ batt, spray and perimeter insulation
- HVAC: heat pump, improved SEER, GSHP, two zone GSHP
- Hot Water: tank, GSHP assist
- Lighting: incandescent, fluorescent, CF, daylighting
- Appliances: Energy Star, high efficiency

Orientation, Annual Energy Consumption
(1,000 kWh)

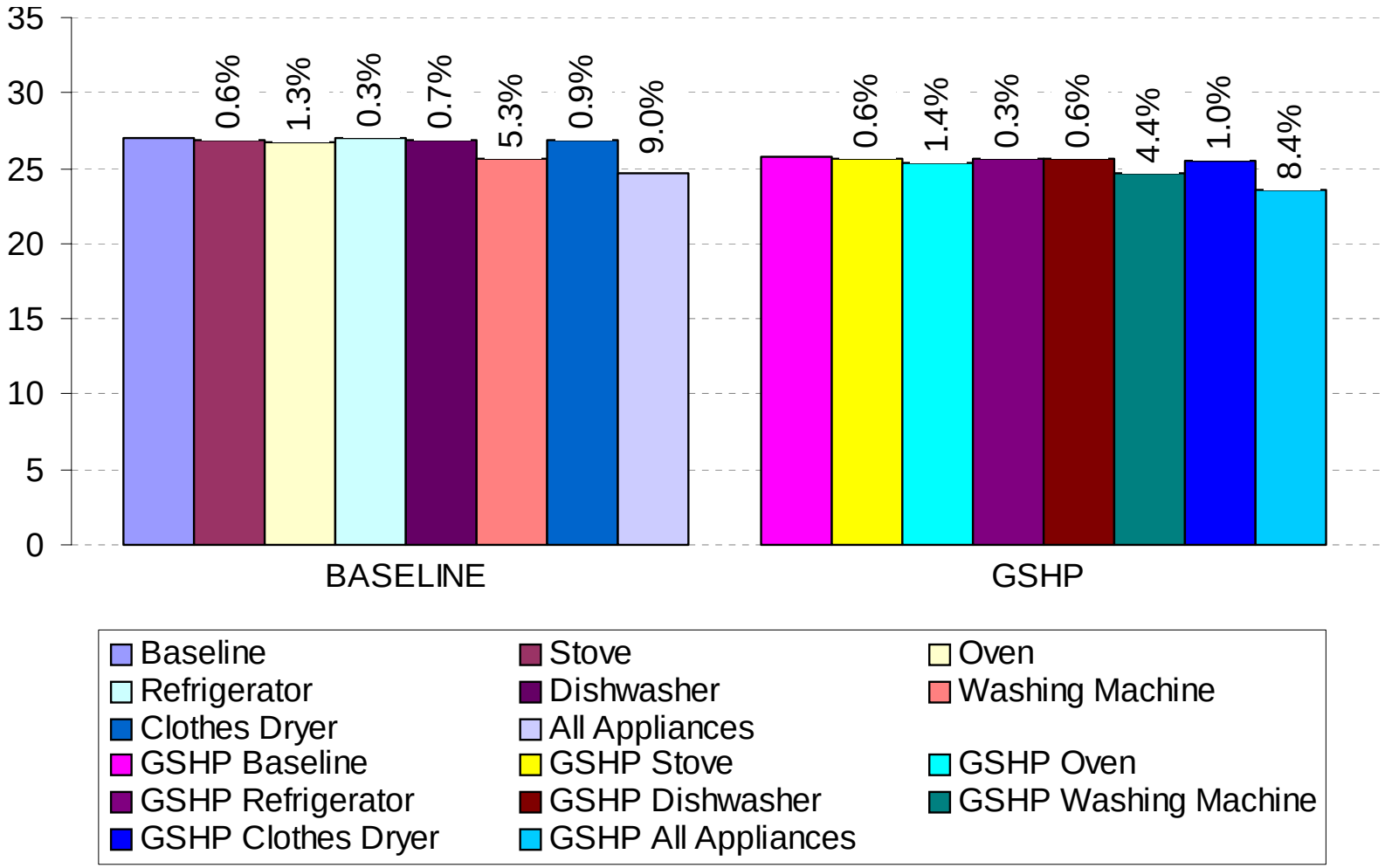


Lighting, Annual Energy Consumption
(1,000 kWh)

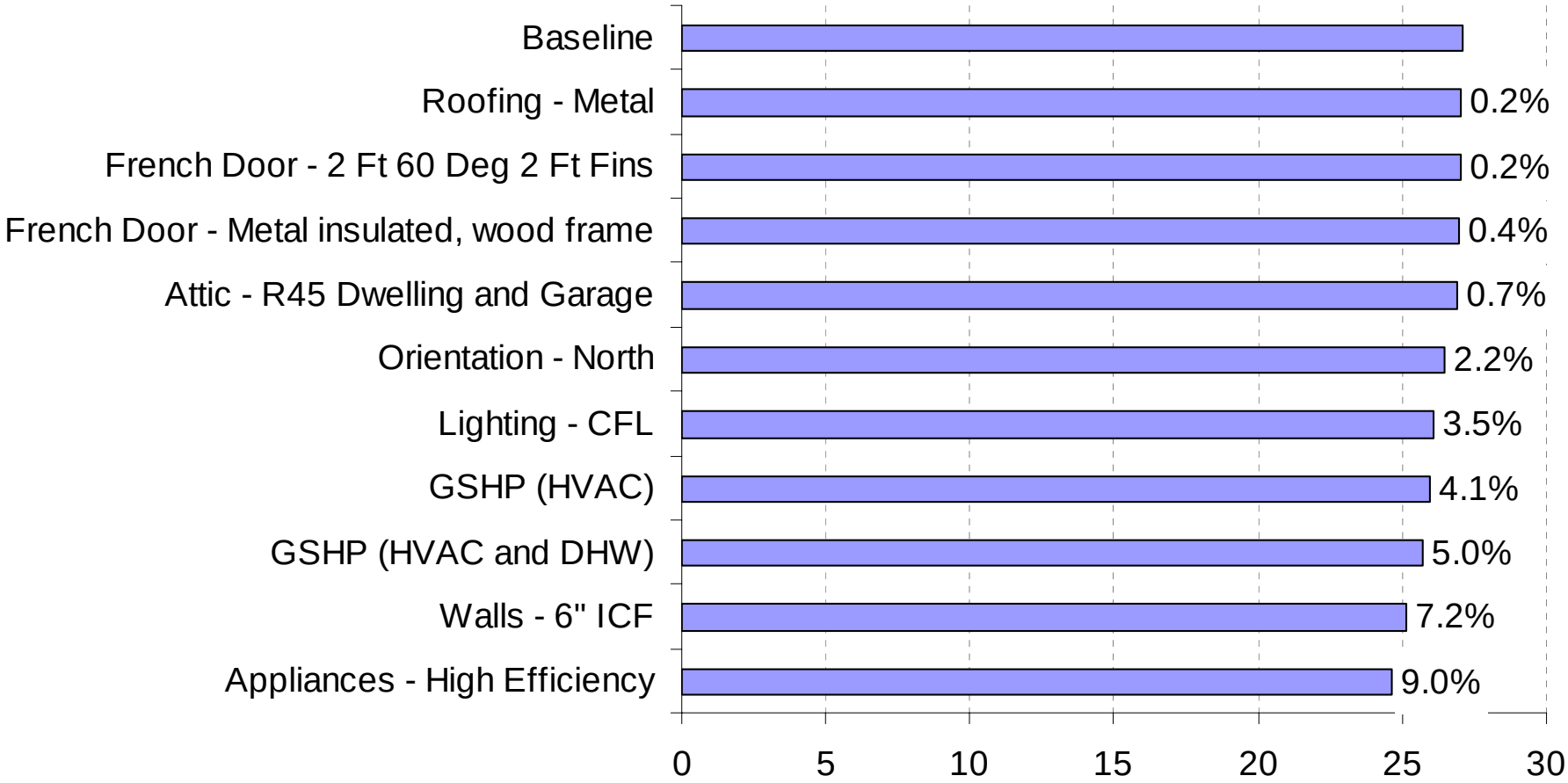


Appliances, Annual Energy Consumption

(1,000 kWh)



Summary of Parametric Savings



Model Issues/Deficiencies

- Software developed for commercial buildings
- Accuracy associated with specific components and systems uncertain
- Little detailed data available for verifying baseline modeling results
- Energy requirements also dependents on behavior of the occupants
- Modeling all possible design options time consuming

Potential Next Steps

- Integrated design process for developing synergies between architecture and mechanical/electrical systems
- Natural day-lighting options
- Dual loop ground source heat pump
- Model south facing windows with overhangs to take advantage of solar gain in winter, and shading summer sun
- Construction cost estimates for feasibility analysis
- Code review to determine minimum requirements for building envelope and mechanical/electrical systems

Questions

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Energy Modeling Results

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This work was funded through the Office of the Assistant Secretary of the Army (Installations and Environment) and conducted under contract W74V8H-04-D-0005, Task N.0440.